ENERGY CONSERVATION

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POLYMERS AND ENERGY CONSERVATION WORKSHOP SUMMARY, WASHINGTON, D. C., NOVEMBER 3–4, 1977

THE TECHNICAL PROGRAM HAS BEEN PREPARED BY THE PLASTICS INSTITUTE OF AMERICA, INC.

Work Performed Under Contract No. EC-77-C-03-1387

Courtesy Associates, Inc.
Washington, D. C.

U. S. DEPARTMENT OF ENERGY

Division of Industrial Energy Conservation

NOTICE

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I. INTRODUCTION

The idea for a Polymers and Energy Conservation Workshop developed in early 1977. Until that time the Department of Energy had relatively little interaction with the polymer community. Although many and varied materials research and develpment programs existed in the different parts of the Agency, little attention had been paid to polymers.

In order to attempt to fill this void in the area of energy conservation R&D, this workshop was planned for late 1977. The purposes of the workshop were:

1. To introduce the polymer community to the Department of Energy, and in particular, to the Energy Conservation Programs;

2. To begin a dialogue between the polymer community and DOE;

3. To ask the polymer community, in an informal way, what programs and problems they thought the DOE should be pursuing in the area of Polymer Science R&D;

4. To discuss via formal presentations, some of the pertinent areas of interest on the part of DOE in Polymer Science R&D.

Our plan is to continue the dialogue and attempt to incorporate the suggestions which resulted from the workshop into the appropriate DOE programs.

II. GENERAL SUMMARY

The general conclusions and recommendations of the Polymers and Energy Conservation Workshop are as follows:

1. There is a need for more technology transfer on the part of the Federal Government in order to assist industry in adopting some of the new energy efficient technologies.

2. Emphasis should be placed on development of new polymeric materials and processes which consume less energy and/or can utilize feedstocks or energy sources other than petroleum and natural gas.

3. The Department of Energy should consider sponsoring fundamental research in areas which are related to recycling of polymeric materials. The research should include work on long-term properties and structure-property relations of the recycled polymers.

4. The Federal Government should initiate tax incentives or subsidies to stimulate the plastics recycling area.

5. More R&D should be sponsored in investigation of combustion of solid municipal waste including the problems of chlorine-containing polymers.

6. Materials research related to recycling polymers including corrosion and materials of construction for heat recovery devices should be increased.

7. It would be very useful to have a comprehensive economic study of recycling/reuse of plastics versus using waste plastics as a fuel.

8. The safety aspects of increased use of plastics in automobiles should be considered by the Federal Government.

9. An important general area for polymer R&D as related to energy would be investigations of basic mechanisms of polymer degradation and the effects of the environment on the degradation rates and mechanisms.

III. AGENDA

DEPARTMENT OF ENERGY/POWER SYSTEMS DIVISION

POLYMERS AND ENERGY CONSERVATION WORKSHOP

November 3 and 4, 1977

Capital Hilton Hotel
Washington, D.C.

THURSDAY, November 3, 1977 9:00 AM - 12 Noon Federal Room

9:00 a.m. SESSION I MODERATOR

Dr. Gail Garbarini
Branch Chief
Intermediate Temperature Industrial Processes
Division of Industrial Energy Conservation
DEPARTMENT OF ENERGY

(Formerly Chief of Materials and Fabrication Branch)
(Division of Conservation, Research and Technology)
(ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION)

9:10 a.m. STATEMENT OF PURPOSE OF CONFERENCE

Dr. John A. Belding
(William Burnett, substituting)
Acting Director
Power Systems Division
DEPARTMENT OF ENERGY

9:30 a.m. THE FUTURE FOR PLASTICS:
HOW WILL ITS GROWTH IMPACT ON THE ENERGY SCENE

Mr. Joel Frados
Publisher
PLASTICS FOCUS

10:15 a.m. COFFEE BREAK Foyer II

POTENTIAL ENERGY SAVINGS IN THE MANUFACTURE, PROCESSING AND USE OF POLYMERS

10:30 a.m. "Energy Saving in Processing"

Mr. Bernie A. Olmsted
Manager of Engineering
Reed Prentice Division
PACKAGE MACHINERY COMPANY

11:00 a.m. POLYMERS IN THE TRANSPORTATION INDUSTRY AND ENERGY CONSERVATION

Dr. William J. Burlant
Executive Engineer
FORD MOTOR COMPANY

11:30 a.m. "Polymeric Packaging--A Route to Energy Conservation"

Mr. Michael F. X. Gigliotti
GIGLIOTTI & ASSOCIATES, INC.
(formerly with MONSANTO COMPANY)

12 Noon LUNCH ON OWN

THURSDAY, November 3, 1977 1:00 p.m. - 7:00 p.m.

1:00 p.m. SESSION II A WORKSHOPS

Title	Moderator	Room
#1. Energy Saving	B. A. Olmsted	Federal Room
#2. Energy Conservation	W. J. Burlant	Senate Room
#3. Polymeric Packaging	M. F. X. Gigliotti	California Room

2:45 p.m. COFFEE BREAK State Room Corridors

3:00 p.m. SESSION II B
Workshops #1 through #3 Repeated Locations as Above

4:45 p.m. SESSION II C
COMMITTEE REPORTS Federal Room

FRIDAY, November 4, 1977 8:45 a.m. - 12 Noon Federal Room

8:45 a.m. SESSION III

MODERATOR

Dr. W. Lincoln Hawkins (Alan Spaak, substituting)
Research Director
PLASTICS INSTITUTE OF AMERICA, INC.

8:50 a.m. WORLDWIDE VIEW OF THE REUSE AND THE RECYCLING OF PLASTICS

Dr Jack Milgrom
Senior Staff
ARTHUR D. LITTLE, INC.

POTENTIAL ENERGY SAVINGS BY EXTENDING THE USEFUL LIFE OF PLASTICS

9:35 a.m. "Status Report on Recycling of Manufacturing and Used Scrap"

Dr. Harvey Hancock and Dr. Richard Donovan
WESTERN ELECTRIC COMPANY

10:15 a.m. COFFEE BREAK Foyer II

10:30 a.m. "Status Report on Recycling of Plastic Scrap in Municipal Waste"

Dr. Harvey Alter
Director of Research Programs
NATIONAL CENTER FOR RESOURCE RECOVERY, INC.

11:00 a.m. "Combustion and Heat Recovery from Polymeric Materials"

Mr. Wallace Hart (Clifford Cantrell, substituting)
Manager
JOHN ZINK PROCESS SYSTEMS

11:30 a.m. "Extending the Useful Life of Polymers by Stabilization"

Dr. W. Lincoln Hawkins (Alan Spaak, substituting)
Research Director
PLASTICS INSTUTUTE OF AMERICA, INC.

FRIDAY, November 4, 1977 — 1:00 p.m. - 3:40 p.m.

1:00 p.m. SESSION IV A — WORKSHOPS

	Title	Moderator	Room
#1	Recycling of Manufacturing Scrap	H. Hancock	Continental Room
#2	Recycling of Plastic Scrap in Municipal Waste	H. Alter	Ohio Room
#3	Disposal of Plastic Scrap	C. Cantrell	New York Room
#4	Useful Life Extension of Polymers by Stabilization	A. Spaak	Michigan Room

2:45 p.m. SESSION IV B — COMMITTEE REPORTS — Federal Room

3:30 p.m. — CLOSING REMARKS

Dominic J. Monetta
Senior Energy Research Center Coordinator
DEPARTMENT OF ENERGY

IV. ABSTRACTS OF PRESENTATIONS

A. Statement of Purpose of Conference

Dr. John Belding
Director
Power Systems Division
Department of Energy

Since the Department of Energy is a newly formed entity, a description of the goals and general organization were given along with the names of the top officials. The introduction to the conference described what DOE hoped to accomplish in the workshop including: an introduction to an industry and technological group not generally involved in DOE programs, the importance of the polymer industry to energy problems and the goals of DOE, and general opportunities for energy conservation in the polymer industry. It was DOE's hope that this workshop would be the beginning of a long-term relationship and that the results would be translated into a meaningful conservation R&D program with DOE and industry.

B. The Future for Plastics: How Will Its Growth Impact on the Energy Scene

Joel Frados
Publisher
Plastics Focus Newsletter
New York, New York 10017

While future growth rates for plastics will be nowhere near as spectacular as they have been in the past, they still will be well above average. This paper explored projected growth into the 1980's, the character of the markets and products that will sustain this growth, and the new directions in R&D into materials and processes that will influence the patterns of growth. Emphasized was how such growth can impact on energy consumption (myths versus realities) and, conversely, how much of the growth can be attributed to plastics' role in energy conservation (e.g., as a substitute for more energy-intensive materials, as a candidate for residential insulation, as a replacement for heavier materials in Detroit's lightweighting programs, etc.). Potential alternate sources for the manufacture of feedstocks for plastics were also be discussed.

C. Energy Saving in Processing

Bernie A. Olmsted
Manager - Plastics Machinery Engineering
Reed-Prentice Division
Package Machinery Company

The manufacturers of plastics processing machinery have been actively engaged in designing for efficiency for some time. The energy crunch of a few years ago not only created a shortage of plastics feedstock but brought home the need for energy savings in machine design.

Many companies had been involved in this type of activity for many years before the energy problem became apparent. Part of this effort had to do with efficiency of design in order to provide competitive machine performance at a competitive price. This resulted in reducing consumed horsepower during operation without impairing machine performance.

The other area for reducing energy consumption has been to improve machine efficiency for the same energy outlay. This translates into higher production for less energy consumption.

This paper gave examples of this effort and the results.

D. Polymers in the Transportation Industry and Energy Conservation

William Burlant
Engineering and Research Staff
Ford Motor Company

The emphasis by the automotive industry on weight reduction and energy conservation has been reflected in continually increasing plastics usage. Plastics require less energy--compared with competing systems--to produce and fabricate, may be recyclabl and offer the potential of even greater weight savings through the use of composite technology. About 160 pounds of plastics now are used on the average passenger vehicle; development of additional applications such as seats, structural members, hoods and decklids may double this figure over the next 5 to 7 years.

Approaches to conserve energy include:

- o Optimum part design
- o Filled polymers
- o Foamed polymers
- o Foam-core structures
- o High strength composites
- o Solid phase fabrication
- o Recycling of used plastics

The above-mentioned issues and approaches were discussed in the talk.

E. Polymeric Packaging - A Route to Energy Conservation

Michael F. X. Gigliotti, P. E.

With the advent of barrier polymers--polymers that are inert and resist the passage of moisture and gases--polymeric packaging materials are displacing metals and glass in many difficult food and beverage applications. In combination with metals, glass and fibrous sub-strates, polymeric packaging materials are also enabling engineers and designers to create new attractive and utilitarian packages, and to solve many heretofore difficult packaging problems.

These developments have significant and beneficial energy conservation implications. The new polymeric packaging is lightweight. The polymers themselves have low energy content. The forming processes use extremely low amounts of energy. The polymers are reformable at extremely low energy costs, and in some cases the containers are reusable, providing additional energy-conservation opportunities.

Planning for a national policy of energy-conservation should appropriately include the benefits of converting from heavy, high-energy-cost, metal and glass packaging systems to light-weight, low-energy-cost, monolithic or multilayered polymeric packing systems.

F. Worldwide View of the Reuse and the Recycling of Plastics

Jack Milgrom
Senior Staff
Arthur D. Little, Inc.
35 Acorn Park
Cambridge, Massachusetts 02140

The nations of the world have now entered into a period of material and energy shortages and more costly disposal of their wastes. Therefore, recycling of the ever-increasing volume of plastic wastes becomes more and more important. Today, with the plastic container for carbonated beverages on the scene in the United States, recycling becomes essential.

But, recycling plastic wastes as fabricated products, which offers the most energy savings, depends upon: (1) a continuous source of scrap; (2) technology for recycling; (3) end-use applications and markets for the products based on these wastes, and most importantly, (4) good economics. Frequently, recycling programs have been launched with a bang and dissolved with a whimper, because one of these conditions was not met. This paper discussed how recycling programs in the United States, Europe and Japan are faring today.

G. Recycling of Telephone Plastic Within the Bell System

Harvey G. Hancock
Western Electric Service Center
Nashville, Tennessee

Refurbishing Techniques

The Bell System has been refurbishing telephone plastic for many years by many different processes. The primary plastic being used since 1962 has been acrylonitrile-butadiene-styrene (ABS) at the rate of 20 million pounds per year. These recycling programs are buffing by mechanical means and semi-automatic processes; painting by either outside contractors or a Western Eletric Service Center. These two types of recovery avoid the regrinding and molding process by recovering approximately 70 percent of the material returned by the telephone companies.

Process Line

After the above refurbishing, the fallout is submitted for granulating. This was started in 1971 in Nashville by using a small granulator and a small contractor. It now involves the following equipment:

1) Sorting Station
2) Hammermill
3) Magnetic Drum
4) Aspirator
5) Two Gravity Tables
6) Granulator
7) Double Deck Screener

Energy Savings

This process line as used will recover approximately 7 million of the 10 million pounds currently being scrapped this year. By recovering this material, an estimated 30,000 barrels of oil in plastic and 30,000 barrels in associated energy to generate and transport can be conserved.

Acknowledgments

Mr. P. Hubbauer - BTL, Murray Hill
Mr. H. E. Kern - BTL, Murray Hill
Mr. R. Eastman - Nassau Recycling
Mr. G. F. Kirk - Western Electric, Atlanta

H. Recycling PVC

R. C. Donovan, A. J. Pompeo, and E. Scalco
Western Electric Company
Engineering Research Center
Princeton, New Jersey

As a result of renovations and expansions in Bell System central offices, considerable amounts of wire and cable are scrapped and become a valuable source of copper and plastic. For many years, the copper has been reclaimed from this scrap and recycled into new Bell System wire and cable. Recent development efforts have focused on the recovery and recyclability of the polyvinyl chloride (PVC) plastic from this scrap, and a reclamation system has been devised to recycle the scrap plastic into new cable product.

I. Status Report on Recycling of Plastic Scrap in Municipal Waste

Harvey Alter, Ph. D.
Director of Research Programs
National Center for Resource Recovery, Inc.
1211 Connecticut Avenue, NW.
Washington, D.C. 20036

Recovery of materials and prepared fuel from mixed municipal waste is an emerging industry, both in the United States and abroad. Each year, an increased number of plants is brought on-line and plans initiated for new ones for the recovery of both materials and energy. In spite of this growth, to date there are no plans for recovering plastics from mixed municipal waste. Municipal waste contains typically perhaps only 3 percent, certainly less than 5 percent, of plastics. This small amount makes a diverse mixture of polymer types, thus limiting reuse. There is little technology in evidence today for recovery of the plastics in a form and to a specification that would permit reuse. The near-term future prospect is that the plastics fraction be included as part of energy recovery; plastics are not detrimental to most methods of energy recovery. The far-term future prospect is that the amount of plastic in our waste will increase, thus indicating that methods of recovery of usable plastic should be explored. Some methods which have been proposed hold promise for future implementation. The limitation of waste plastics on reuse, the effect of plastics in various methods of energy recovery, and possible methods of recovering plastics as usable materials were reviewed.

J. Combustion and Heat Recovery from Polymeric Materials

Wallace Hart
General Manager
Process Systems Division
John Zink Company
Tulsa, Oklahoma

All plastics manufacturing processes produce some off-specification material that must be disposed of. Land filling has been used, but this is both expensive and undesirable ecologically.

This paper described a process developed by the John Zink Company for combustion of waste plastics with heat recovery in the form of steam generation. Design considerations and economics were also presented.

K. Extending the Useful Life of Polymers by Stabilization

W. Lincoln Hawkins, Research Director
Plastics Institute of America, Inc.

All polymeric materials, whether natural or synthetic, degrade when exposed to oxygen, ozone, or water. The reactions of degradation are accelerated by heat, ultraviolet radiation, and mechanical energy. Those synthetic polymers which are of greatest commercial importance, including poly (vinyl chloride), the polyolefins, polystyrene, the urethanes and others, degrade rapidly unless properly stabilized. For example, unprotected low-density polyethylene, a flexible thermoplastic which can be elongated up to 600 percent, becomes completely brittle after only 1 or 2 years exposure out-of-doors. Unstabilized poly (vinyl chloride) becomes highly discolored after short outdoor exposure. Stabilizers have been developed, however, to give excellent protection against the reactions of degradation. Incorporation of 2 or 3 percent of a selected carbon black extends the useful outdoor life of polyethelene from 2 to over 50 years. Other stabilizers, which have been designed to interrupt the degradation mechanism, are adaptable to clear formulations. Incorporation of effective stabilizers into a polymer as it is first formulated not only assures adequate life for the original application, but also provides sufficient protection to permit recycling of scrapped material.

V. SUMMARY OF WORKSHOP SESSIONS (Edited Transcript)

Federal Room
Capital Hilton Hotel
Washington, D.C.

Committee Reports
November 3, 1977, 4:45 p.m.

Garbarini:

This afternoon we will have the summary sessions of the workshops. Each session moderator will give the results of his workshop, which will be recorded and compiled into a report. A copy of the report will be sent to each attendee. If anyone has a question, please use the microphone in the middle of the floor.

Mr. Olmsted will present the first report.

Olmsted:

Our two discussion groups were totally different from each other. The first was oriented toward the factual and pragmatic, and the second was concerned with broad, general concepts, such as future development, research programs, and funding.

The first group felt that energy conservaton is basically an economic problem--that economic pressures will force changes in the marketplace, that industry will adopt available energy-saving techniques, and that legislation is not necessary. Tax write-offs as motivators were discussed and discarded. It was pointed out that many energy-saving techniques now exist which are compatible with presently used processes. These techniques are known but are not being used. There was much discussion of how to educate people to take advantage of them. It was suggested that the Energy Department come up with some methods of informing industry about and encouraging the use of the known technologies to reduce energy consumption. The general conclusion, however, was that a price/cost squeeze will force their adoption. As large industrial operations attempt to save energy to bring their costs and prices down, in time smaller operations will be forced to adopt energy-saving measures to stay alive in the marketplace, that is, to keep their bids competitive.

The second group discussed research programs: Who should do research? How should it be funded? How can industry be motivated to put some money into it? If the Department of Energy sponsored research programs in colleges, would industry support them? It was pointed out that most industries are reluctant to spend money on long-range projects in which they do not have a definitive position. It is difficult for an industry to justify putting money into a research program that does not promise some market superiority. This group never reached any definite conclusions on how to handle the problem or came up with any proposals on which projects to tackle first. But it was an interesting and informative discussion.

(There were no questions.)

Gigliotti:

In both our groups, I posed the question, "What should the Department of Energy do about the energy-conservation aspects of polymeric containers and packaging?" and ran through some data charts. Most of the information is freely available in magazines or published documents of the Environmental Protection Agency and the Food and Drug Administration.

In both groups there was much side discussion on matters of public health which seem to becloud the issue of plastic packaging at the present time. There was, however, general agreement on four conclusions relative to the question posed. First, we concluded that real and large energy-conservation benefits are achievable through the use of polymeric packaging, both currently and potentially in future technologies. Second, there are regulatory and other public impediments that appear to stand in the way of our realizing these benefits to the fullest extent. Third, the negative public image of chemicals and plastics is a major source of some of the impediments. Finally, we concluded that DOE should take a leading role in educating both Government agencies and the general public about the energy-conservation benefits and potentials in the use of polymeric products, especially packaging.

(There were no questions.)

Burlant:

A number of key issues were discussed in our two groups. Some of these were process development, energy conservation in processing, physical and mechanical properties of plastics, their long-term durability, their fatigue and fracture mechanisms, and recycling and reuse of plastics (there is much hazy and obscure information in this area). The crashworthiness characteristics of plastics are yet to be determined. Reliable test methods must be developed to gather the much needed data in this area. Also discussed were the cost of research, the role of Government and legislation in research and uses of plastics, and potential usage of plastics as related to such characteristics as flammability.

We concluded that it is very important to continue the kind of interaction exemplified by today's meeting and important, too, that Government and industry cooperate in research and development programs. One example pointed out was the cooperative program between the Bud Company and a Government agency to study the energy absorption of plastics in crashes. The purpose of this project was to study the amount of energy that can be absorbed by filament-wound structures and filament-wound tubes in crash situations. Based on the results of this study, it was concluded that, if properly designed, plastic trains and trucks can absorb considerable amounts of energy and will not shatter on impact. This sort of cooperative program could be very useful in several other areas.

We also concluded that the establishment of a volunteer advisory board consisting of people from the industry or plastics societies, with no vested interest in forthcoming projected cooperative programs, be considered. We want to emphasize that the members of the board must be volunteers working without pay with the Department of Energy to establish R&D approaches to key issues and programs. We felt that the board should have some authority in choosing areas in which work would be done, its primary objective being to see that the data generated would be valuable to everyone involved.

Finally, we all wanted to say that we feel this has been a very fine conference with an excellent degree of participation and that everyone, without exception, has made contributions.

(There were no questions.)

Garbarini:

I would like to thank you very much for your participation. I especially want to thank the speakers, the moderators. We gave them a very tough job. They had to do a lot of work this afternoon to put together the summary programs.

(At 5:05 p.m. the Thursday summary session was concluded.)

Committee Reports
November 4, 1977, 2:45 p.m.

Spaak:

We would like to continue our program now and hear committee reports from the chairmen of the various committees. I believe Harvey Hancock wants to be first because he has to catch a plane. The first report is "Recycling of Manufacturing Scrap."

Hancock:

It was a very interesting workshop, and I would like to thank the people who came.

We came up with six items that we thought would be good topics for DOE to work on. Item one is transportation. Transportation costs for goods to be recycled penalize recycling, e.g., the minimum freight load for which one is charged is about 25,000 pounds, and there may be approximately 10,000 pounds of usable material in it. Perhaps a break could be given to materials or goods that were going to be recycled.

Item two is Federal support programs, not necessarily subsidies or tax incentives for reuse of materials and machinery, but perhaps support in providing technology and developmental research.

Item three is stimulating use of recycled polymers other than as landfill. Perhaps they could be used in original products of lower grade.

Along the same line, item four is developing techniques for recycling polymers that can be made into other useful products.

Item five is setting up a clearinghouse for ideas that would be available to industry and/or institutions so that groups could swap ideas back and forth in useful exchange.

The last item is making a survey of industry to determine what wastes are available and what, if anything, can be done to recover the major portion of the energy that was put into the original product.

Spaak:

Our next report is "Recycling of Plastic Scrap in Municipal Waste." Harvey Alter.

Alter:

We had a very active discussion, to the point of being late in reporting out; so I have not had an opportunity to organize our thoughts. We discussed the rich plastics wastes from both household and other sources in municipal wastes. Our conclusions came out somewhat different from those of Mr. Hancock's group.

First, we recognized that the properties of the plastics per se, the thermodynamics and micromechanics of plastics, do not lend themselves readily to reuse either in a mixture or contaminated.

Further, we do not see at this time the likelihood of technology for a clean separation of plastics by type from the waste sources we were concerned with in a form that could be reused. This led us to discuss the very narrow specifications, the many grades, and the high cleanliness in the plastics industry.

We concluded that virgin plastics have been developed in narrow grade ranges to meet very specific applications, to lower costs,

and to reduce manufacturing wastes. If this conclusion is true and if it indeed leads to lower costs and reduced wastes, it is in itself an energy-conservation move, and there is merit in having many grades of plastics. This, then, would argue for keeping the tight specifications. The ensuing discussion was related to the difficulty of separation and to the fact that there are no new technologies on the horizon.

If specialization does lead to less energy consumption, where, then, does this leave us? We have left the utilization of both industrial and municipal wastes containing plastics as a source of fuel. There is potential for using both these kinds of wastes in utility and industrial boiler houses. We restricted our discussion to industrial boiler houses because no representatives from utilities were present. We then looked at some technical and economic barriers to wider utilization of plastics as fuel.

A number of points were made. First, it was felt that industry is more likely to adopt this form of fuel if energy can be produced efficiently using equipment off the shelf, i.e., if the users can go out and buy equipment already developed. We also discussed the economics of self-generated power, its cost versus the cost of equivalent purchased power.

Next we discussed the potential for mixing, e.g., mostly cellulosic wastes with mostly plastic wastes as a means of achieving a specification fuel, i.e., using the low heating value of cellulose and the much higher heating value of plastics blended together in some ratio to give a fuel similar to that which the operators are accustomed to using--mid-continental United States coal. However, the performance in the boiler of materials with relatively high plastics contents must be investigated. It was also suggested that fluidized combustion of refuse-derived fuels be investigated, particularly as a means of handling chlorine-rich plastics, and that this might offer the greatest opportunity for drawing off the generated hydrogen chloride.

Next we spent some time discussing what might be done to alleviate the risks perceived by boiler operators in using wastes as fuel. One suggestion was that we might appeal to their sense of pride in demonstrating the new technology. Another was to make large quantities of fuel available to potential users. Let me explain to those of you who are unfamiliar with this field. It is somewhat of a chicken-or-egg problem. A municipality cannot afford to make the fuel unless it has a long-term contract with a buyer, but a buyer

is not likely to sign such a contract until he has been able to try the fuel. This problem might be solved by making available some source of supply of large tonnage quantities for trial purposes. As a final means of alleviating the perceived risks, it was suggested that there be more activity to inform potential users of what is being done in the field and thus, it is hoped, to dispel fears and misunderstandings.

Spaak:

Does anyone have anything to add?

Comment from the Audience:

I think I agree with the recommendations in regard to utilization of municipal wastes, but I find it very difficult to accept the conclusion in the very general phrasing in which you have expressed it, especially in light of the presentation this morning by the people from Bell Laboratories, who discussed a whole scheme for recycling PVC which they apparently are moving ahead on. And I think we can cite other cases where recycled plastics are being used and even converted back to prepolymers or monomers.

I want to express my strong disagreement with the generalization that used plastics are just good for fuel.

Alter:

You misunderstood, and it is my fault. As I said, there was no time to organize our notes. I am reading from scribblings.

We agreed in our group to eliminate completely from the discussion first manufacturing waste; that is not our purview. That is a kind of industrial horizon, specific manufacturing of scrap. Let me draw an analogy to flashings, screws, and gates on an ejection molding. That is not the kind of waste we are talking about. If my group will permit it, I will put that in the same category as what you referred to from this morning's session, the PVC recycling at Bell Labs. We were not looking at that kind of wastes. We were looking at industrial waste rich in plastics, which is different from industrial waste plastics. For the latter wastes, I agree with everything you have said.

Spaak:

The next report, "Disposal of Plastic Scrap," will be presented by Clifford Cantrell.

Cantrell:

I think we probably had a little overlap in our discussions. Our group discussed several of the aspects that have already been brought out. I will try not to replow the ground.

Our discussion was more concerned with industrial plastics wastes than with consumer wastes. As was pointed out, once the plastics get into the hands of the consumer the problem of reuse is infinitely complicated. We chose to skip lightly over that and to talk about industrial wastes. I will try to mention specific points that have not been covered previously.

One specific industry, polypropylene, was represented by Dr. Chinn, who stated that some research should be done in finding alternate uses for a packet-type polypropylene, which represents 5 to 10 percent of the propylene production in the United States. That is a fairly significant tonnage. Work is being done overseas in using the converted materials in concrete in subbasements, and we felt that this would be a fruitful area for study.

We would also like to see some fundamental research on corrosion of materials used to construct heat-recovery devices when plastics are used as fuel. Very little work has been done in the field of phosphoric acid corrosion. This was mentioned with PVC problems. Some companies have worked with chlorinated hydrocarbon combustion and have some experience with heat recovery, but not with phosphorus Also, certain other compounds would lend themselves to investigation of the strictly metallurgical aspects of corrosion. I think it would be a fruitful area and of general interest and benefit to the public.

We felt that perhaps general research to set up guidelines for recycling and reuse of plastics versus use of plastics as fuel would be of interest to the general public in making decisions as to whether we want to burn plastics waste or reuse it. The gentleman from Western Electric gave a very good discussion of reuse.

Finally, we felt that there should be some study of the relative merits of combustion of plastic materials as a portion of the

fuel for coal-fired stoker-type boilers. Can plastics be put in to supplement the fuel in existing boilers as opposed to building new installations to burn plastics wastes? What percent would be economical and feasible?

We felt that these areas are specific enough and generate enough interest that they warrant some looking at. In general, we feel, like others here today, that there is a great need for fundamental education. Probably DOE could take on this task of educating the public on the advantages and disadvantages of plastics.

These are the points we discussed that were not covered by others here today.

Spaak:

The next report is "Useful Life Extension of Polymers by Stabilization."- Charles Rogers.

Rogers:

I would like to thank the members of the workshop for their very active participation.

We discussed essentially three general areas: first, the need for and the problems involved in long-term stabilization or recycling stabilization of plastics; second, some procedures that might be recommended; and third, specific recommendations to DOE.

The first thing I want to bring up is that somehow we must establish a basis for deciding whether manufactureres, or whoever, should design plastics products for long life or for recycling. Explicit designs facilitate one or the other. A good example brought up was water glasses. Should a plastic water glass be designed to last a long time? If so, it would not be immediately disposable, and we would have to consider in the cost the energy expended to wash it, etc. If the glass is designed to be disposable, however, the total cost of its manufacture, use, and disposal must be considered. All three factors frequently are not considered by the consumer, who usually takes account of only the first two, the manufacture (i.e., the buying cost) and the use life; no thought is generally given to the cost of disposal. Then, too, if the glass is to be recycled, it must be fabricated and stabilized in that context.

We also recommend that all designs of recycle processes include consideration of product properties. In other words, we must

consider not only engineering aspects but also chemical aspects to ensure that the product of the recycling process has properties commensurate with the cost and effort of recycling; that, in turn, would guide us to establish good stabilization processes. Related to this consideration, obviously, it is a fact that research studies must be made to establish recycling conditions. Otherwise the development and application of stabilizer systems to maintain good properties would be done essentially in the dark.

We must know the conditions during the recycling. All of this can be brought about only if the manufacturers, the processors, and the users of plastic articles have some motivation for spending the time and effort to develop the systems. In view of this necessity, we suggest that the Government set the example and guide industry and users in getting optimal properties with minimal expenditure of money and energy.

Finally, we felt that there is certainly not enough research anywhere, either industrial or academic research, on any of the basic problems in attaining long-term stabilization. On polymer systems, for example, there is essentially very little research sponsored by the Government. What we need particularly are studies of the basic degradation process--of how the polymers deteriorate. Weathering studies are continuing, but fewer studies of degradation and weathering are being carried on today than were being done a decade ago. We are still carrying out Edisonian research in which we try to obtain systems by straightforward attempts. I do not mean that science is not used but only that the effort of research and development is not commensurate with the need.

Associated with the need for more research are side problems, such as the compatability of polymers, the interactions between stabilizer systems, and the realization that research and development efforts that will lead to good industrial systems depend on accelerated study and on developing interactions in real systems not just in model systems.

Spaak:

On behalf of the Plastics Industry, I would like to thank each of you for participating. Over the last 2 days we had active participation by the members who have attended this session. I, for one, appreciate your attendance and indulgence today and appreciate DOE for their sponsorship. Thank you very much for coming. I wish you a very pleasant trip home.

(At 3:15 p.m. the Friday summary session was concluded.)

VI. CONCLUDING ADDRESS

Dominic J. Monetta
Senior Energy Research Center Coordinator
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Thank you for attending the workshop and for participating so actively in it. The last 2 days have been very challenging. R&D planning is quite complex, as we have all discovered, but you have all risen admirably to the challenge. From what I have seen in the last 2 days, and from the summaries presented this afternoon, I feel we are succeeding with our experiment in interactive planning. Before we conclude, however, I would like to restate and summarize the philosophy of what we are trying to do here, a philosophy that sometimes gets lost in the need to generate specific results.

When we formed the Office of Conservation in the Energy Research and Development Administration, we wanted to put together a group that was not exclusively end-item-oriented. In that way, applied research that needs to be done but that does not directly go into a specific piece of hardware would not get lost. That spirit of experimenting with new approaches to R&D planning is the basis of this interactive workshop. Interactive planning is essentially bringing together small groups of knowledgeable people to briefly work together in an attempt to develop a dialogue between the people out in the field and our people in the Federal Government. This is the intent of what I consider to be a series of management experiments. This workshop was very dynamic and very organic, and an experiment. This, to me, means it is a part of a search and not the entire answer.

You have given us excellent inputs to our planning process and made valuable recommendations for the division's R&D program and the workshops themselves. Your contributions are very timely because of the recent establishment of the Department of Energy and the internal reorganization it entails.

You know a lot more than we do, no matter what our titles seem to indicate, and getting positive interaction and dynamic dialogue going between you and us, we consider critical. What we would like to do is set up a continuing dialogue: a nonbureaucratic, nonformalized discussion. It is an opportunity to present to you what our thinking is, try to get you to react to our thinking, and try to develop a feeling of relevancy. In Washington, we tend to reinforce our own thinking and develop tunnel vision. When this happens,

our programs may lack significance and lose touch with reality. Through the dialogue, you have the opportunity to tell us whether we are funding and thinking about the kinds of things that you consider important. We need to know and understand your concerns to broaden our vision and improve our planning.

The process of these workshops is a great part of the product: the process of getting to know who you are and what your concerns are, and letting you get to know us in the same way. This exchange produces valuable communication, not the formal type that takes place over letterheads, but phone calls and discussions, informal conversations, the kinds of exchange that really are part of the creative process. That is what we are trying to do and it is sometimes difficult. We need your help in developing that process as much as we need your help on the technical specifics of the Division of Power Systems' program.

In light of the contributions you have made, the division will be reviewing its plans for fiscal year 1978 and the succeeding fiscal years. The conclusions and recommendations in the summary report on what we have done here--which you should receive in about 90 days--will be incorporated into our planning efforts. The report, however, is hopefully not the end of our joint venture. Let us continue the dialogue begun here in Washington both formally and informally. Call us or write us about your concerns and thoughts, and please visit us whenever you are in Washington, D.C.

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